PROJECT ABSTRACT

IoT Poultry Farm Environment Monitor

An ESP32-based environment monitor for poultry sheds that continuously senses temperature, humidity, ammonia and light, judges every reading against bird-comfort bands, raises heat-stress and ammonia alerts, and drives an exhaust fan automatically — with a live shed dashboard showing gauges, comfort bands, trends and an event log.

Project type: Hybrid (hardware sensor node + software dashboard)

Availability: Built to order

Suitable branches: IoT & Embedded, Electronics / E&TC, Electrical

Technologies: ESP32, DHT22, MQ-137 ammonia sensor, LDR, relay + exhaust fan, buzzer, Arduino IDE, comfort-band dashboard

Price: Request a quotation

Prepared by Projectech · projectech.in — for academic project reference.

1. Introduction / Background

Poultry productivity is decided more by air than by feed formulation. Birds outside their thermal comfort band eat less, grow slower and become susceptible to disease; ammonia (NH_3) released from litter irritates airways and eyes, depresses weight gain and, at high concentrations, raises mortality. Light schedules (photoperiod) further control laying and growth cycles. Yet on most small and mid-size farms these variables are still judged by walking the shed and by smell — slow, subjective and easy to miss at night.

Low-cost microcontrollers now make continuous shed monitoring practical: an ESP32 with commodity sensors can watch the shed around the clock and present the numbers against bird-comfort bands instead of raw readings, so a farmer — or a final-year student — can see trouble hours before birds show symptoms.

2. Problem Statement

Manual shed checks miss developing heat stress and ammonia build-up because both worsen between visits, and human senses are poor gauges of either. Standalone temperature meters, where they exist, give numbers without context: 27 °C means something different for day-old chicks than for six-week broilers. There is no low-cost system that watches all four shed variables continuously, interprets them against bird comfort bands, alerts on heat stress and acts on it automatically.

This project fills that gap with a single ESP32 node — DHT22 for temperature and humidity, MQ-137 for ammonia, LDR for photoperiod — running comfort-band firmware that raises warning and alarm tiers, sounds a heat-stress buzzer, drives an exhaust fan automatically, and reports everything to a live shed dashboard.

3. Objectives

- Continuously sense shed temperature, humidity, ammonia and light with a single ESP32 node.
- Judge every reading against configurable bird-comfort bands with warning and alarm tiers.
- Raise local heat-stress and ammonia alerts (buzzer + dashboard events) before birds show symptoms.
- Drive an exhaust fan automatically with hysteresis when temperature leaves the comfort band.
- Track photoperiod against the configured lighting schedule for layer sheds.
- Present gauges, a 24-hour comfort-band chart, event log and control status on a live dashboard.
- Report node and sensor health so faults are visible as faults, never mistaken for clean data.

4. Proposed Methodology

The node samples the DHT22, MQ-137 and LDR on a fixed cycle. Firmware filters the readings, converts them to engineering units, and compares each against its comfort band — in-band, warning band, alarm band. Warnings flag WATCH on the dashboard; alarms fire the buzzer, start the exhaust fan and log an event with the reading and timestamp. Readings are pushed over Wi-Fi to the dashboard, which draws gauge needles against band gradients, the 24-hour temperature curve against the comfort band, and a timestamped event log. The light sensor accumulates on/off hours against the configured photoperiod schedule. The MQ-137 is burned in for 24–48 hours before calibration and its load resistor tuned per the calibration procedure; comfort-band tables for broilers, layers and chicks are adapted from the tuning guide.

5. System Architecture / Working

- The DHT22, MQ-137 and LDR sit at bird height in the shed, wired to the ESP32; the exhaust fan, relay and buzzer complete the node.
- Firmware samples on a fixed cycle, filters readings and converts them to °C, %RH, ppm NH_3 and lux-indicative light level.
- Each reading is classified per cycle: in-band, warning band or alarm band (stored, configurable constants).

- Warning-band entry logs a WATCH event and updates the dashboard; alarm-band entry fires the buzzer, starts the fan and logs the heat-stress or ammonia event.
- Fan control uses hysteresis around the setpoint so the relay does not chatter at the boundary.
- Readings and events are pushed over Wi-Fi to the dashboard: gauges with band indicators, 24 h comfort-band chart, event log, control status.
- Photoperiod is accumulated against the configured schedule; deviations raise schedule-fault entries.
- Heartbeats with sensor status confirm node health; missed heartbeats raise communication-fault entries.

6. Hardware / Software Requirements

- ESP32 development board with Wi-Fi
- DHT22 (AM2302) temperature-humidity sensor — –40 to 80 °C (±0.5 °C), 0–100 %RH (±2–5 %RH), per datasheet
- MQ-137 ammonia gas sensor module — SnO_2, NH_3 detection, 5–500 ppm range, 5 V heater, per datasheet
- LDR light sensor module
- Single-channel relay module + 5 V exhaust fan
- Active buzzer for heat-stress alarm
- 5 V regulated power supply for the node
- Shed dashboard: HTML/CSS/JS single-file web app
- Firmware: Arduino IDE (ESP32 core)

7. Expected Outcomes

- A wired ESP32 sensor node monitoring shed temperature, humidity, ammonia and light continuously.
- Comfort-band firmware that classifies every reading into in-band, warning and alarm tiers with configurable thresholds.
- Local heat-stress buzzer alarm and automatic exhaust-fan control with hysteresis.
- A live shed dashboard: four gauges with band indicators, 24-hour temperature-vs-comfort-band chart, event log and control status.
- Photoperiod tracking against the configured lighting schedule.
- Sensor calibration and band-tuning procedures documented for different bird types and ages.
- Node-health reporting so faults surface as faults rather than silent bad data.

8. Applications

- Broiler and layer sheds on small and mid-size poultry farms.
- Brooding houses where chick comfort bands differ sharply from grower bands.
- Poultry research and college farm demonstration sheds.
- Ventilation-design studies comparing fan schedules against measured comfort hours.
- A reference build for livestock-environment monitoring curricula.

9. Limitations

- MQ-137 readings are indicative comfort bands, not laboratory-grade measurements: 24–48 h burn-in and periodic recalibration are required, and humidity drift plus cross-sensitivities are documented.
- DHT22 humidity accuracy degrades at sustained high humidity (>90 %RH); extreme readings are approximate.
- Comfort bands ship as design defaults — they must be adapted to the actual bird type and age per the tuning guide.
- The system warns and ventilates; it does not replace litter management and stocking-density practices that control ammonia at source.
- Wi-Fi must reach the shed: the local buzzer and fan run offline, but dashboard logging pauses during an uplink outage.

10. Future Scope

- Multi-shed deployment with per-shed nodes feeding one farm-level dashboard.
- CO_2 and dust (PM) sensing for deeper air-quality profiling.
- GSM/SMS alerts for farms without shed Wi-Fi coverage.
- Feed-intake and weight-gain correlation studies against measured comfort hours.
- Solar-powered node variants for off-grid poultry farms.
- Mobile-app alerts and farmer-facing vernacular-language dashboard.